Where will an increase in cellular capacity come from?

From FierceWireless

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Traffic loads on cellular networks are growing at a faster pace than technology can accommodate. The latest Cisco Visual Networking Index estimates that mobile data traffic grew by a factor of 2.6 during 2010, and the index forecasts a 26-fold increase over the next five years (Figure 1), most of it driven by video and other real-time traffic. While LTE, WiMAX, and HSPA+ are more spectrally efficient than 3G technologies, the performance gains are not even close to meet the expected data traffic demand over the next few years.

To date, mobile operators have tried to contain the problem of congestion mostly with Wi-Fi off-load to relieve high stress points in their network and with the introduction of traffic caps that limit traffic from the heaviest users. Wi-Fi off-load has worked well for many operators, but Wi-Fi spectrum is limited and Wi-Fi is heavily used for other applications as well. As a result, its role in addressing the capacity crunch in the long term is necessarily restricted, especially since it uses license-exempt spectrum that everybody is entitled to use.

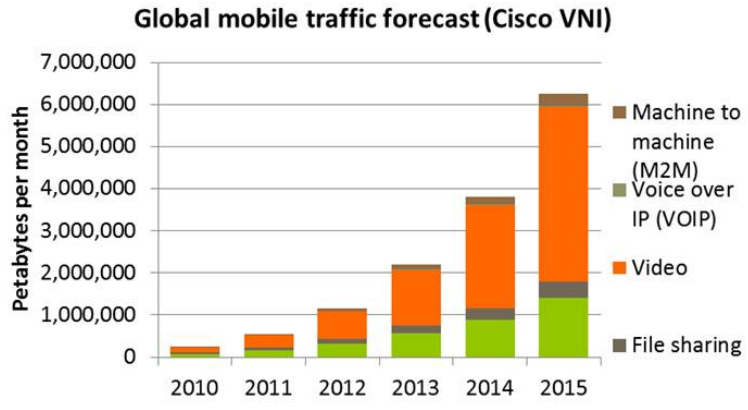

Figure 1 Global mobile data traffic forecast (Cisco VNI). Source: Cisco

So far there is little evidence that traffic caps have reduced the impact of network congestion, or, for that matter, of traffic levels. In a recent report available at www.senzafiliconsulting.com I argue that traffic caps fail to specifically target traffic levels at peak hours (and, in fact, may encourage more usage at peak hours, with subscribers trying to save bandwidth on activities at off-peak hours, which are often considered less urgent or valuable). This is a real limitation in the efficacy of traffic caps because traffic during off-peak hours is essentially free to operators. It is only peak hour traffic that really matters-and that is responsible for congestion.

In the longer term, more than Wi-Fi offload and traffic caps are needed to increase network capacity-and perhaps even more importantly its capacity density (Mbps per square mile) in high-concentration locations, and its network utilization level (percentage of network capacity used) across the day. At the same time, operators also have to strive to improve network efficiency, by trying, for instance, to flatten traffic throughout the day, to reduce peak-hour traffic and increase off-peak traffic. Different strategies can be used to increase efficiency. For instance, the operator can encourage subscribers to avoid P2P or large software updates during peak hour, or provide lower rates (or higher traffic allowances) for off-peak traffic.

While most would agree that the need to accommodate more traffic is one of the main challenges that the industry is facing, there is much less agreement on what is the most effective way to increase capacity, capacity density, network utilization, and network efficiency. Multiple effective piecemeal solutions exist in the market, but to address the capacity challenge operators need to step back and develop an end-to-end strategy that assesses the role of different solutions and how they can be integrated to maximize their benefits. Addressing the capacity challenge requires more than a few more macro base stations and a blanket of Wi-Fi access points. A new approach to network planning and deployment is needed-one in which RAN and core network are more closely integrated and, which is based on coexisting heterogeneous components.

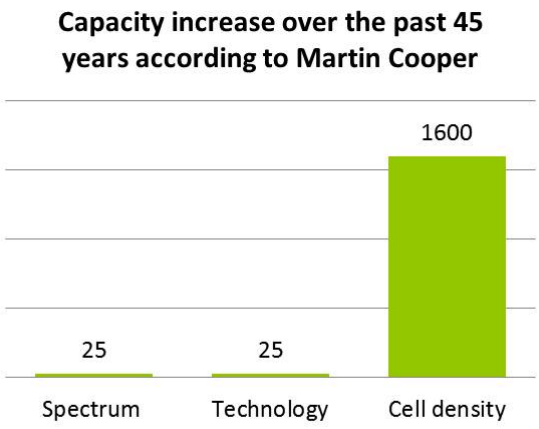

Figure 2. Capacity increase over the last 45 years according to Martin Cooper. Source: Arraycomm

If no single solution is sufficient to address the increase in data traffic, which solutions are going to be the most effective and most widely used? What are the low-hanging fruits that operators should focus on?

Martin Cooper, who lead the Motorola team that developed the first mobile phone, estimates that over the last 45 years, the increase in cell density accounted for a 1,600-times increase in capacity in cellular networks (Figure 2). By comparison, the availability of new spectrum and technology are both responsive for a 25-fold increase in capacity. While impressive, the extraordinary impact of cell density stems from network deployments aimed at achieving near-ubiquitous geographical coverage-and that could only be done by adding more cells in a wider area.

The trend has now changed. Mobile networks may not cover 100 percent of the operator's footprint, but they reach almost every home in developed countries, and increasingly in emerging countries as well. The increase in capacity in cellular networks in the future will not come so much from expanding the coverage, but by deepening it-increasing the density of cells in areas where geographical coverage is already established.

Does this mean that the increase in cell density will have a lower impact than in the past? Operators and vendors that have looked at this have concluded that the role of cell density may be somewhat reduced, but it is still the dominating factor (Figure 3). With the commercial availability of small cell options and the improved support for underlay networks in LTE, operators can increase capacity density in a cost effective way and lessen their dependence on the macro network. Macro cells are very powerful at providing coverage but are not as well suited at transporting high data traffic loads, especially from indoor locations, which is where most data traffic comes from. Smaller cells--pico cells, femto cells or Wi-Fi access points, in indoor or outdoor locations--are becoming an increasingly crucial complement to the macro infrastructure taking a central role in emerging heterogeneous networks.

Yet, this is not all. Martin Cooper focused on the radio access network (RAN) capacity, but substantial capacity-or perceived capacity-comes from managing network traffic to protect it from abusive users, to reduce traffic loads at congested locations during peak hours, and to provide differentiated services based on service tiering,

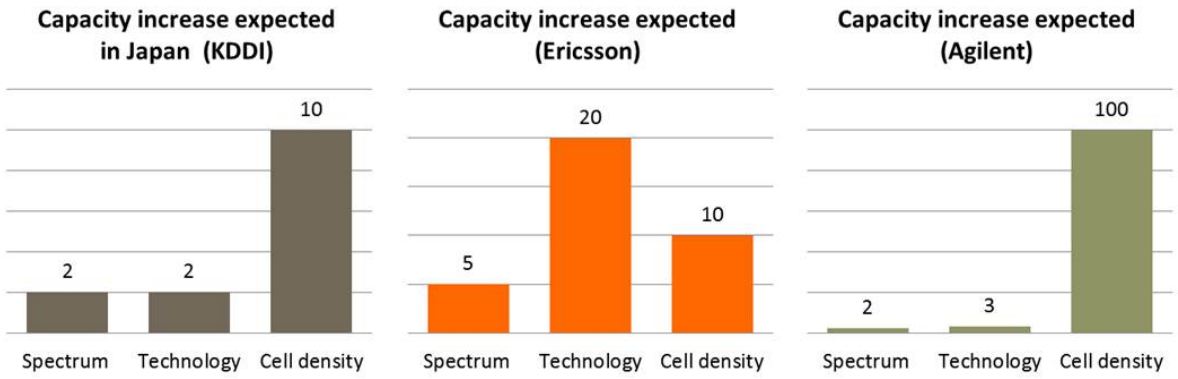

Figure 3. Future capacity increase in cellular networks according to KDDI, Ericsson, and Agilent.
Source: Agilent, Ericsson, KDDI

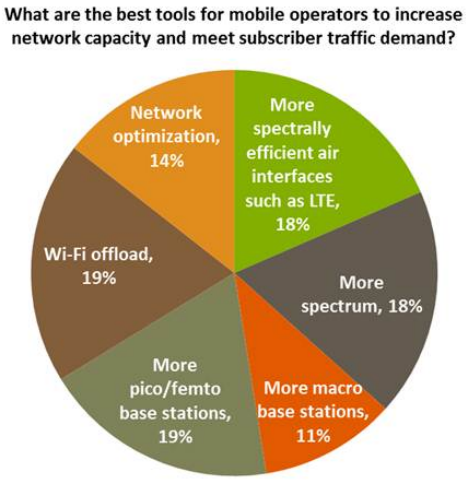

Figure 4. Survey results. Source: Senza Fili Consulting

operator policy and subscriber preferences. Active traffic management with a combination of policy, optimization, and tiering, of course, does not change network capacity, but it may increase the amount of traffic that can be transported over the same network, and improve the quality of experience (QoE) of subscribers.

To get a sense of what may be more important, I asked in a very informal survey limited to people who work extensively on this topic what the best tools to increase network capacity in the near future are. The results (Figure 4) indicate the need for mobile operators to adopt a multi-pronged strategy that includes the adoption of different solutions to address specific traffic growth drivers. Perhaps even more importantly is the need to integrate those tools across their networks-and across their internal teams that are accustomed to work largely independent from each other.

The complexity of the new emerging networks may be daunting. It requires profound changes in the way mobile services are provisioned and managed. Gone are the days of the price per minute or buckets of minutes. Instead, we have the increased understanding of how the sources of traffic give operators the ability to attack the problem on multiple fronts, giving them more flexibility and room to innovate.

About Senza Fili

Senza Fili Consulting is an analyst and consulting firm that provides advisory services on wireless data technologies and services since 2003. At Senza Fili we have in-depth expertise in financial modeling, market forecasts and research, white paper preparation, business plan support, RFP preparation and management, due diligence, and training. Our client base is international and spans the entire value chain: clients include wireline, fixed wireless, and mobile operators, other service providers, enterprises and other vertical players, vendors, system integrators, investors, regulators, and industry associations.

We provide a bridge between technologies and services, helping our clients assess established and emerging technologies, leverage these technologies to support new or existing services, and build solid, profitable business models. Independent advice, a strong quantitative backing, and an international perspective are the hallmarks of our work.

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About the author

Monica Paolini, PhD, is the founder and president of Senza Fili. She is an expert in wireless technologies and has helped clients worldwide to understand technology and customer requirements, evaluate business plan opportunities, market their services and products, and estimate the market size and revenue opportunity of new and established wireless technologies. She has frequently been invited to give presentations at conferences and has written several reports and articles on wireless broadband technologies. She has a PhD in cognitive science from the University of California, San Diego (US), an MBA from the University of Oxford (UK), and a BA/MA in philosophy from the University of Bologna (Italy). She can be contacted at monica.paolini@senzafiliconsulting.com.